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ABSTRACT

The design and development of GRACILE, a collaborative learning environment in the domain of Japanese language patterns and expressions, is described. The environment is designed to allow learning goals communication, learning activities negotiation, and collaboration between learners. From a group of student models, a potential development level is represented for each learner, representing the knowledge the learner can reach with the assistance of more experienced peers or a teacher. The student model represents the learner's actual development level, by a set of patterns and expressions which appear in correct sentences constructed by the learner, without any help from the system or other colleagues. GRACILE cooperates with each learner, generating the respective student's knowledge frontier, which is defined with respect to the knowledge of other learners and the more complex language patterns which the system believes have already been internalized by the student. The environment provides the learners with a toolbox for dialogue construction, including dictionaries. A set of dialogue agents, whose capabilities are the construction and appropriate use of language patterns and expressions in different dialogue situations, may also be requested for help. During sentence construction, learners can be assisted by other learners. The "Learners Performance Communication" module allows the student free access to open models which represent the group members' actual development level, thereby allowing the learner to locate their own level in relation with the others', and encouraging the learner to realize who can help him/her or who can be helped. It is believed that GRACILE will help Japanese language students develop reading and writing skills faster, allowing them to become more productive at communicating. (Contains 16 references.) (MAS)

Design Issues in a Collaborative Intelligent Learning Environment for Japanese Language Patterns

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Abstract: This paper presents the main issues concerning the design and development of GRACILE, a collaborative intelligent learning environment in the domain of Japanese language patterns and expressions. We present an environment designed to allow learning goals communication, learning activities negotiation, and collaboration between learners. From a group of student models, a potential development level is represented for each learner together with her/his group-based knowledge frontier, which is defined with respect to the knowledge of other learners and the more complex language patterns containing basic patterns which the system believes have already been internalized by the student.

The environment provides the learners with a toolbox for dialogue construction, including dictionaries. A set of dialogue agents, whose capabilities are the construction and appropriate use of language patterns and expressions in different dialogue situations, may also be requested for help. During sentence construction, learners can be assisted by other learners.

Introduction

Japanese language students in Japan face communication problems concerning the appropriate use of language in specific situations, as well as in the comprehension and production of written Japanese. This problem is especially relevant due to the increasing number of people studying Japanese. Nevertheless, research projects on the development of Japanese language learning software for foreigners are few (Hayashi & Yano, 1992; Kusanagi, 1992). CALL systems concerning both grammatical and social aspects of language use are still uncommon (Chanier & Renié, 1993).

Current research on intelligent collaborative systems proposes learning environments that facilitate learning through collaboration. The design of learning environments where students can learn more efficiently and effectively, sharing their knowledge, authority and responsibility in the learning process has been proposed (Chung, 1991). Distant Open Learning systems are approaching the development of systems for the social construction of shared knowledge (Clement, Vieville & Vilers, 1992). Recently, the concept of ICLS (Intelligent Collaborative Learning Systems) (McManus, 1993) appeared, referring to the approach based on the conjunction of ITS and CSCW (Computer Supported Collaborative Work) technologies.

Collaborative Learning by Dialogue Construction

It is considered that the interaction with a second language in its written form represents input from which the learners can discover grammatical regularities more easily than in its spoken form (Krashen & Terrel, 1983; Carrol, 1986). Grammar and writing are important to help the learner rise to a higher level of speech development (Vygotsky, 1986). In second language learning research, there is evidence that techniques which lead to *creative language use* are more appropriate (Carrol, 1986), and it is also accepted that learning environments should provide situations where the learners understand the usage of knowledge through activity. Since the learner who is involved in the authentic activity of writing needs a real audience, this should be provided by the other learners in a collaborative environment (Pacey, 1990). We are of the opinion that by

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constructing a dialogue together with GRACILE, the learners are able to comprehend and construct sentences, thereby discovering language grammar regularities and understanding the relation between Japanese language patterns/ expressions and the situations where they are appropriately used.

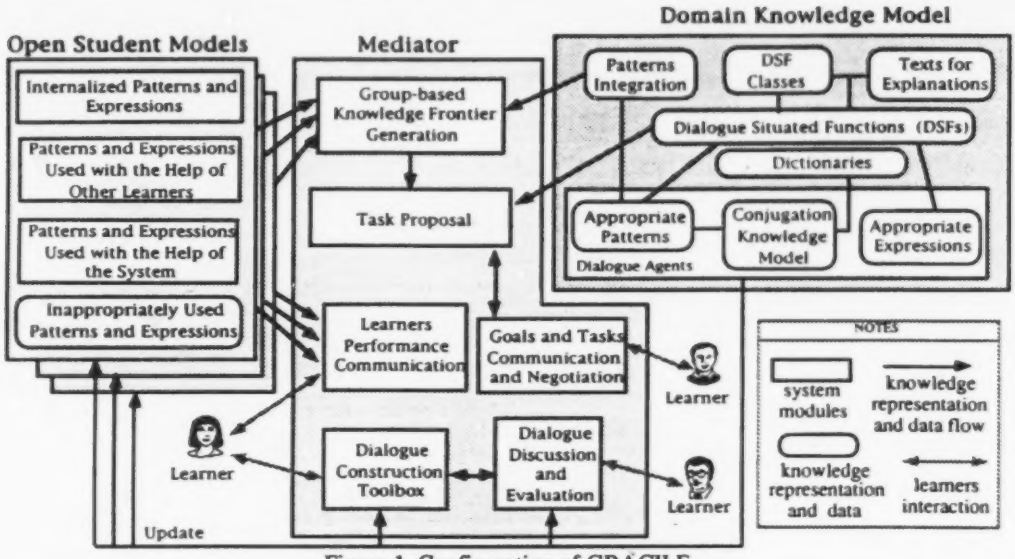

Figure 1. Configuration of GRACILE

GRACILE

We believe the learning of Japanese language patterns and expressions can be more effective as a social activity, where learners play the roles of writers and readers; constructing sentences for a common dialogue, helping each other, and negotiating the domain knowledge to be practiced and its appropriate use. GRACILE's main component is the Mediator, an intelligent agent that cooperates with each learner, generating the respective student's *group-based knowledge frontier*, which represents the knowledge that can be integrated from knowledge acquired by the learner and which has been used by other members of the learning group. The concept of group-based knowledge frontier thus represents the students learning and collaboration opportunities. In this way, each Mediator moderates the negotiation and coordination of the student's learning activities. The architecture of GRACILE is presented in figure 1.

Modeling the Domain Knowledge

Dialogue Situated Functions

A dialogue, as a sequence of sentences, can also be considered as a sequence of accomplished communication goals. Each language pattern and expression has a communicative function that corresponds to a particular communication goal. We call these functions *dialogue situated functions* (hereafter referred to as DSFs), since they appear in a situation of a dialogue. Communication goals are then expressed in terms of DSFs such as "affirmative request", "ask for attention", "show agreement", "apologize", etc. Figure 2 presents an example of a dialogue constructed as a sequence of DSFs expressed by sentences constructed from language patterns and expressions. The domain knowledge is organized by relating the knowledge representation of language patterns and expressions to the corresponding DSFs where appropriately used. Based on the results of a questionnaire to foreigners studying Japanese, we have determined a set of DSFs considered to be representative of the communication goals for a Japanese language student. These DSFs are organized into classes which facilitates their management by the system and the learner.

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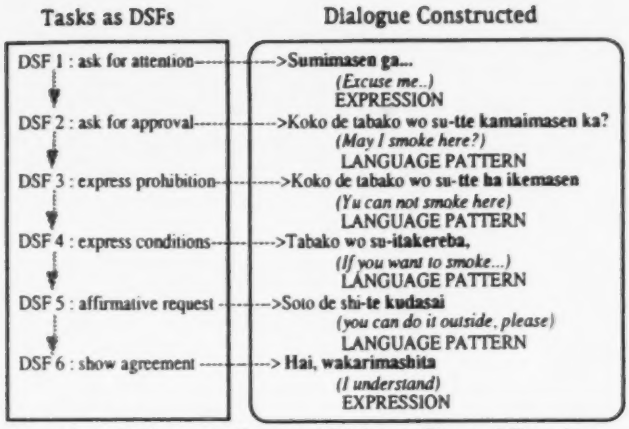

Figure 2. A Dialogue in Terms of Dialogue Situated Functions

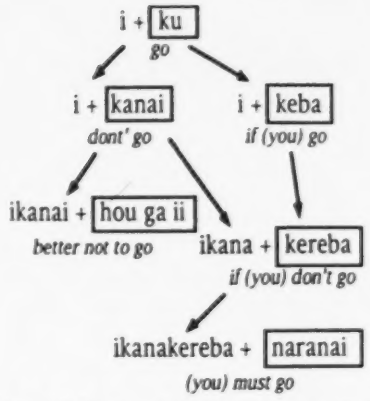

Figure 3. Language Patterns Integration

Language Patterns and Expressions

A *language pattern* is a template representing a general structure for a sentence that includes verb conjugation forms, particles and other grammatical elements. Learning a language pattern implies first understanding the pattern, then producing sentences using it, and finally internalizing the pattern, thereby establishing it as a habit (Alfonso, 1989). Utterances which do not obey tgeneral patterns are called *expressions*. As in the case of language patterns, expressions are also grouped into DSFs where they can be appropriately used. For example, in the case of the DSF "show agreement" we have *hai, wakarimashita* (I understand) and *naruhodou* (I see). Domain knowledge is distributed between dialogue agents, each one representing the different use of language patterns and expressions by Japanese of different gender, age and relative social status.

By providing a pedagogical orientation to our knowledge domain representation, we may relate language patterns through the concept of *integration*. We define integration as the relation between complex patterns which contain one or more basic patterns in their structure (see figure 3). Due to the evidence that language structures are learned in a certain order (Krashen & Terrel, 1983; Carrol, 1986), we consider this integration relation necessary, because it guides the Mediator in the direction of the learner's possible knowledge development.

Student Modeling

Open Student Models

Student models in collaborative learning environments should be open (Self, 1992). For the purpose of establishing a complete communication of goals, needs, and capabilities of the learning group, all student models are freely accessible to the learner at any time with the Learners Performance Communication module. In this way the learners can locate their level with regard to the others (Clement, Vieville & Vilers, 1992). This is relevant for the goal communication process in collaborative learning and curriculum knowledge negotiation (Moyse & Elsom-Cook, 1992; McCalla & Wasson, 1992). In GRACILE, the learner can notice to whom s/he can ask for or provide help while practicing on a specific language pattern or expression.

The Actual and Potential Development Levels

In GRACILE, student models are represented based on the concept of zone of proximal development, defined as the distance between the actual level of development of the learner and her/his potential development level (Vygotsky, 1978). The potential development level represents the knowledge the learner can reach with the assistance of more experienced peers or a teacher. The student model represents the learner's *actual development level* by a set of patterns and expressions which appear in correct sentences constructed by the learner, without any help from the system or other colleagues. This is the knowledge the system believes has been internalized

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by the learner. On the other hand, the learner's *potential development level* is represented by the set of patterns and expressions used in the construction of correct sentences with the assistance from the student's colleagues or from the system. In Vygotsky's terms, *internalization* occurs when an interpersonal process, at the social level, is transformed into an intrapersonal process, at the individual level (Vygotsky, 1978). We consider that a learner internalizes a language pattern or an expression when this knowledge serves her/his current needs and when it has been already used. We believe that internalization only occurs in the case of knowledge that is within the learner's potential development level (Vygotsky, 1986) and appears in some particular context (Krashen & Terrel, 1983; Carrol, 1986). In addition to the actual and potential development levels representation, the student model contains the set of inappropriately used expressions and patterns, representing the student's needs.

The Mediator

Negotiation of the Learning Activities

Negotiation of learning activities is done between the Mediator and the students following the steps below:
step 1.- The Mediator proposes the subsequent knowledge it believes would be more effectively learned by each member of the group, considering the possible collaboration, based on each student's actual and potential development levels. This learner's group-based knowledge frontier representation, together with the learner's goals, provide the negotiation position of the Mediator.
step 2.- Via the Learners Performance and the Goals and Task Communication and Negotiation modules, learners have free access to the actual development level, needs and goals of other learners, and can locate their own goals with respect to the learning group's. Then, they make explicit their learning goals. The learners also negotiate the role to play in the dialogue, indicating gender, age, and relative social status.
step 3.- Based on the learning group's goals and the learner's group-based knowledge frontier, the Mediator proposes a set of tasks to the student, concerning the construction of sentences for specific DSFs.
step 4.- Learners may accept or refuse the tasks proposed to them.

The Group-based Knowledge Frontier

There is considerable evidence that certain language structures tend to be learned before others (Carrol, 1986) and are acquired in a predictable order (Krashen & Terrel, 1983). Once the student has learned how to use some simple patterns, s/he may then learn more complex patterns which contain the known basic ones more efficiently. Since the learning group members are part of a social entity with similar Japanese language experience, the knowledge that is already used by some learners in the group is necessary for group membership and collaboration and may also be more easily learned by the others. The first task for the Mediator is to determine a representation of that knowledge which can be learned more easily, enhance the learner's progress and provide better collaboration possibilities. As mentioned above, we call this set of patterns and expressions the group-based knowledge frontier (see figure 4). Previous work on ITS proposed modeling of knowledge evolution, as was the case with the term "knowledge frontier" appearing in WURSOR (Goldstein, 1982). In GRACILE, we represent the group-based knowledge frontier by the union of two sets: the learner's potential development level and the complex patterns that can be integrated by those basic patterns which the system believes have already been internalized by the learner. The intersection of these sets is called *candidate knowledge for relevant collaboration*. A degree of usability, popularity, relevance and feasibility is assigned, according to the patterns' integration relations and their use by the group.

Interacting with GRACILE

Learners Performance and Goals Communication

The Learners Performance Communication module of the Mediator allows the student free access to open student models which represent the group members' actual development level, thereby allowing the learners to locate their own level in relation with the others'. Each learner is encouraged to realize who can help her/him or who can be helped. This is an important issue for the process of goals selection and collaboration.

Learners can explicitly express their goals either as *delivery goals* or *content goals* (McCalla & Wasson, 1992). Delivery goals refer to the challenge of constructing an appropriate sentence for a specific DSF, where the learner wants to know and practice how to express her/himself properly. A learner expresses a content goal when s/he wants to know about the usage of a language pattern or an expression that s/he has already noticed, and decides to practice it in a situation where appropriate. The learner can also refuse or accept the task proposed to her/him by the Mediator, during the negotiation of the learning activities of dialogue construction.

Sentence Construction

Learners put their knowledge into practice during the construction of sentences with the aid of a dialogue agent assigned to them and/or the other learners, if necessary. During dialogue construction, the learner works directly with nouns and verbs to construct her/his own sentences. The learning environment is designed to provide the student with Japanese-English dictionaries for nouns, verbs and adjectives written in Kanji and Hiragana. More than 850 Japanese verbs and 80 adjectives can be automatically conjugated by a dialogue agent, whose request input can be a verb or an adjective in English with the selection of the desired conjugation features. The request can be also a conjugated verb or a sentence in Japanese, based on a language pattern or an expression. In this case, the dialogue agent presents the appropriate DSF and the pattern or expression meaning in English, together with the verbal and adjectival conjugation features. Assistance from the dialogue agent is registered into the learner's student model, and represents the learner's current needs concerning the construction and use of language patterns and expressions.

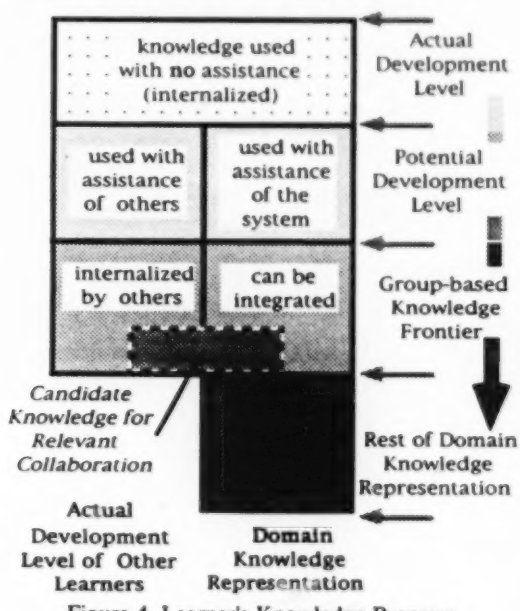
knowledge used with no assistance (internalized)
used with assistance of others
used with assistance of the system
internalized by others
can be integrated
Actual Development Level
Potential Development Level
Group-based Knowledge Frontier
Rest of Domain Knowledge Representation
Candidate Knowledge for Relevant Collaboration
Actual Development Level of Other Learners
Domain Knowledge Representation

Figure 4. Learner's Knowledge Progress

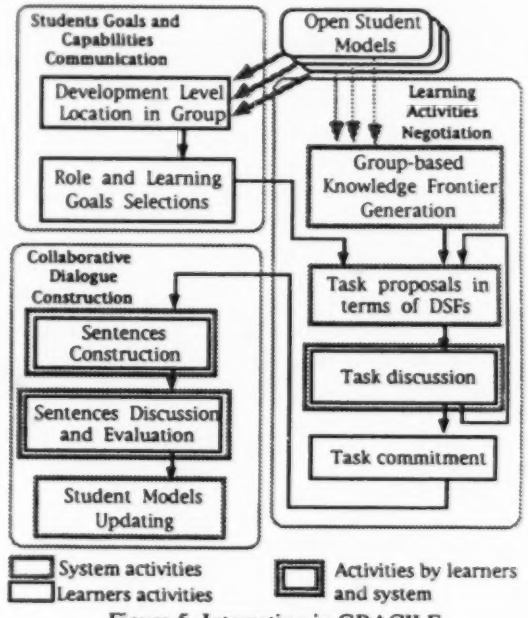

Figure 5. Interacting in GRACILE

Sentence Collaborative Discussion and Evaluation

The knowledge about language patterns, expressions and their appropriate use in a DSF is provided by the dialogue agent, when it receives a request from the learners in order to determine the correctness and the appropriateness of the constructed sentences. The learner may also ask another learner about the appropriate construction and use of a pattern or expression. In this way, the students play both the role of learner as newcomer and as experienced peer. The respective dialogue agent makes an analysis of the constructed sentence, manipulating its knowledge representation of the patterns and expressions according to its age, gender and status. Then the dialogue agent determines whether the sentence is grammatically correct and appropriate to the specific dialogue situation. A constructed sentence, as a part of a shared dialogue, should be accepted by all members and be either discussed or rejected. In the latter case, other learners can assist and propose modifications. The sentence

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evaluation is expressed in terms of the assistance from other learners or the dialogue agent corresponding to the role the student is playing in the dialogue, which in turn determines if that knowledge has still not been internalized by the learner. After the construction and evaluation of a sentence, the Mediator updates the respective learner's student model. Figure 5 presents the interaction with GRACILE's learning environment in general terms.

Conclusions

We have presented the configuration and the characteristics of GRACILE, a collaborative intelligent learning environment for learning Japanese language patterns and expressions, where learners write sentences together in situations where the domain knowledge is appropriately used. In order to adapt itself to the goals and needs of the learners, the Mediator proposes a set of tasks to the student in terms of dialogue situated functions, based on the knowledge the Mediator considers the student may integrate next and on what it believes has been already internalized by the student and the other members of the learning group. This group-based knowledge frontier is important since it represents the possible collaboration from other peers in the scope of the evolution of the learner's knowledge. We believe that GRACILE is a learning environment that will help Japanese language students develop their reading and writing skills faster, allowing them to become more productive in their communication of Japanese. GRACILE is being developed in Prolog for a network of Macintosh computers.

References

Alfonso, A. (1989). *Japanese Language Patterns: A Structural Approach*. Center of Applied Linguistics, Sophia University , Tokyo.

Carrol, J.B. (1986). Second Language, *Cognition and Instruction*. Dillon, R.F. and Sternberg, R.J. (eds.), Academic Press, London, 83 - 125.

Chanier, T. & Renié, D. (1993). Modelling Language Usage to Enhance Second Language Learning. *Proceedings of AI-ED 93*, AACE, Paul Brna, Stella Ohlsson and Helen Pain, (eds.), 260-272

Chung, J. (1991). Collaborative Learning Strategies: The Design of Instructional Environments for the Emerging New School, *Educational Technology* 31 (12), 5-22.

Clement, D., Vieville, C. & Vilers, P. (1992). An Experiment of Cooperative Learning with Hypercard, in *Computer Assisted Learning, ICCAL'92*, I. Tomek, ed. Springer Verlag, 148-160.

Goldstein, I.P. (1982). The Genetic Graph: A Representation for the Evolution of Procedural Knowledge, in *Intelligent Tutoring Systems*, D. Sleeman and J.S. Brown, (eds.), Academic Press, London, 51-77.

Hayashi, T. & Yano, Y. (1992). Open Structured CAI Systems for Kanji Learning, in *Computer Assisted Learning, ICCAL'92*, I. Tomek, ed. Springer Verlag, 271-282.

Krashen, S.D. & Terrel, T.D.(1983). *The Natural Approach.: Language Acquisition in the Classroom.* Pergamon Press, Oxford.

Kusanagi, Y. (1992). CAI for Teaching Japanese as a Second Language, *Journal of Japanese Language Teaching*, (78), 1- 8 (in Japanese).

McCalla, G. & Wasson, B. (1992). Negotiated Tutoring Needs, Student Modeling and Instructional Planning: Arguments and Experiences from the Perspective of the SCENT Project, in *Knowledge Negotiation*, R. Moyse and M.T. Elsom-Cook (eds.), Academic Press, 41-68.

McManus, M. (1993). The Group Leader Paradigm in an Intelligent Collaborative Learning Environment. *Proceedings of AI-ED 93*, AACE, Paul Brna, Stellan Ohlsson and Helen Pain, (eds.), 249- 256

Moyse, R. & Elsom-Cook, M. (1992). Knowledge Negotiation: An Introduction. In *Knowledge Negotiation*, R. Moyse and M.T. Elsom-Cook (eds.) Academic Press, 1-19.

Pacey, B. (1990). Meaningful Language Learning in the Age of Technology, in *Computers in Education*, A. McDougall and C. Dowling (eds.), Elsevier Science Publishers, 681-686

Self, J. (1992). The Role of Student Models in Learning Environments, in *Proceedings of the IAIA 92* Nagoya, Japan, 103-110.

Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, London.

Vygotsky, L.S. (1986). *Language and Thought*, MIT Press.